Space Weather Technical Forecast

Issued on Wednesday, 01 December 2021 at 12:45 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor Storm activity.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was very low, with no significant flares detected. There are currently four sunspot regions visible, with AR2898 (Cao/Beta) in the southwest showing some weak trailing spot development, and AR2900 (Dao/Beta) near the southwest limb, persisting with a simple bipolar magnetic configuration. AR2901 (Bxo/Beta) in the northeast has now almost faded, and AR2902 (Dro/Beta) showed some consolidation of spots as it moved into the northwest, and now with rudimentary penumbrae in both leading and trailing groups. AR2903 in the southeast faded during the period. No Earth-directed CMEs were seen in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind environment, as measured by DSCOVR at L1, was indicative of CIR effects and high speed stream connection overnight. Slow-ambient speeds showed a steady strengthening from 30/1900 UTC, reaching around 500 km/s by 01/0100 UTC, and with a peak of 580 km/s at 01/0624 UTC before ending the period near 520 km/s. Density rose to above average values for a time, peaking at 40 ppcc at 30/1934 UTC, before falling back to mostly average values by 01/0100 UTC. Total IMF Bt became mostly moderate 20/1600-010500 UTC, reaching 15 nT at times 30/2000-2300 UTC, and with its north-south component Bz seeing negative (southward) deflections of -13 nT 30/1900-2200 UTC. Phi angle switched to a negative (toward sun) direction from 30/1300 UTC, before moving to a predominantly positive orientation by 30/1900 UTC. Resultant geomagnetic activity was Quiet to start, but increased to G1/Minor Storm level 30/2100-2400 UTC. Active intervals were then recorded, until becoming Unsettled by 01/0900 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at background levels. High energy electron flux (greater than 2 MeV) as observed by GOES-16 reached moderate levels through the diurnal peak on 30th. The associated 24-hour integrated fluence remained well below the Active threshold (1e8 integrated pfu), on a slight rising trend until 01/0000 UTC, when 5.29e6 integrated pfu was recorded.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to remain predominantly very low, with a chance of C-class flares, primarily from ARs 2898 and 2900 in the southeast.

Solar Wind / Geomagnetic Activity: Continued enhancements from various coronal hole fast winds are expected through the period, including CH26/+ on day 1 (1st), then CH27/+ likely on day 2 or during day 3 (2nd or 3rd), with lingering effects lasting into day 4 (4th). A filament eruption which left the Sun on the 29th, may also bring a brief elevation to solar wind speeds during day 2 (2nd) as Earth sees a glancing blow. Geomagnetic activity is expected to be mostly Unsettled, but with some Active spells, and a chance of G1/Minor Storm intervals, these most likely on 2nd and 3rd Dec.

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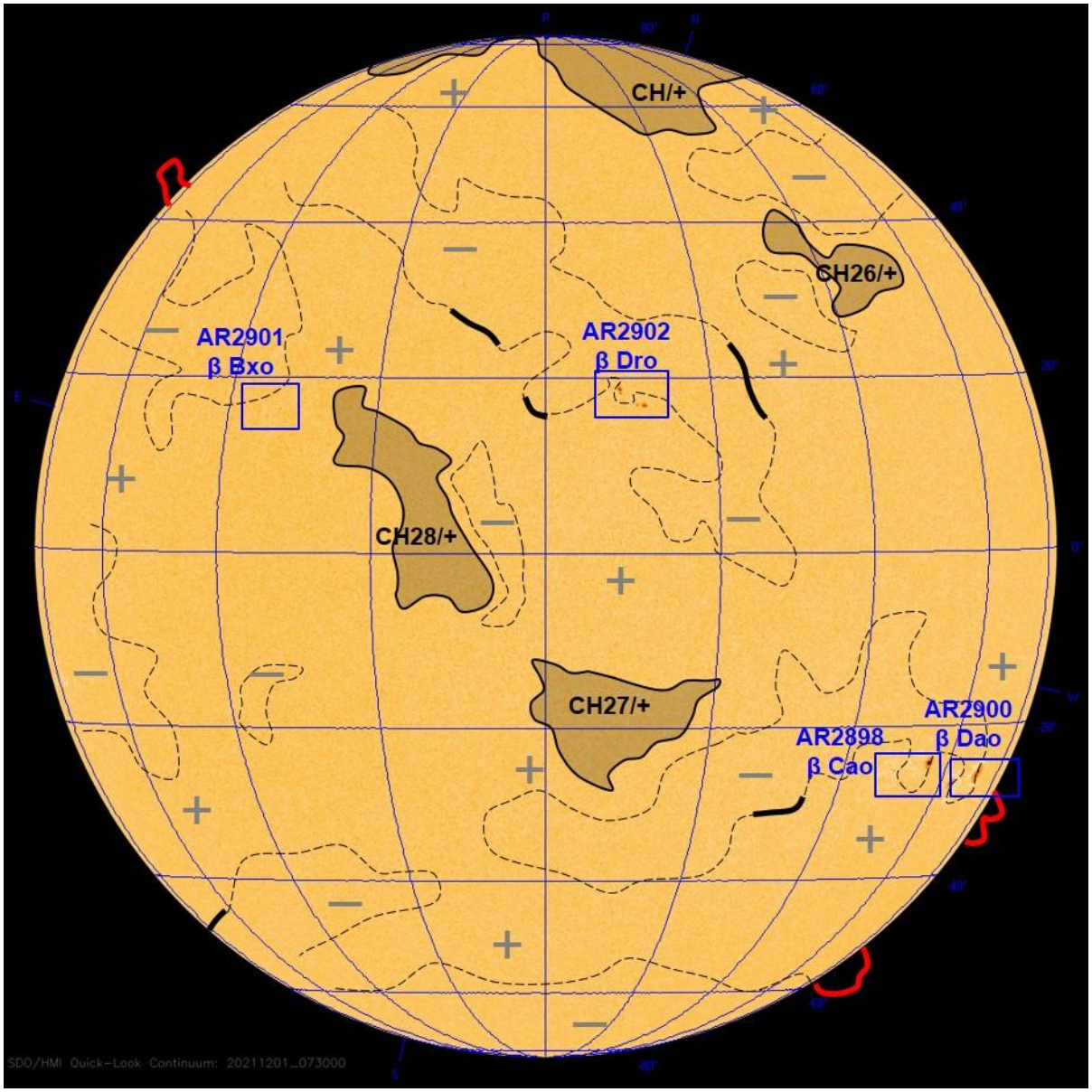
Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at background levels. The high energy electron flux (greater than 2 MeV) is likely to be at background to moderate levels, with the next notable enhancement likely to be from the arrival of the faster winds from CH27 on day 2 or 3 (2nd or 3rd). If this occurs, the fluence may rise as a result, but it is currently expected to remain below the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 01/0800 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A filament eruption which left the south centre disk of the Sun on the 29th may bring a brief elevation to solar wind speeds during 2nd December as we encounter a glancing blow, though the majority of the ejecta is expected to go below the Earth. There are no other Earth directed CMEs in the forecast.

The solar wind parameters indicated CH26/+ HSS connection on the evening of 30th November. There are expected to be lingering but waning effects on 1st December, although with no further significant impacts expected. CH27/+ appears to be a more notable feature, and whilst its fast wind is not expected to arrive until 2nd or 3rd December, there is the potential for a very fast solar wind (near 700 km/s, which has been observed from some coronal holes in the southern disc during the last month). Enhanced observed solar winds from STEREO-A on 29th may also indicate potential faster solar winds from this feature reaching Earth on 2nd.

Consequently geomagnetic activity is expected to be mostly Unsettled, but with Active spells likely and a chance of G1/Minor Storm intervals, these most likely on 2nd and 3rd Dec.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	20	50	50	20
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Past 24 hour solar wind parameters at L1, showing CIR and high speed stream onset through the first half of the period

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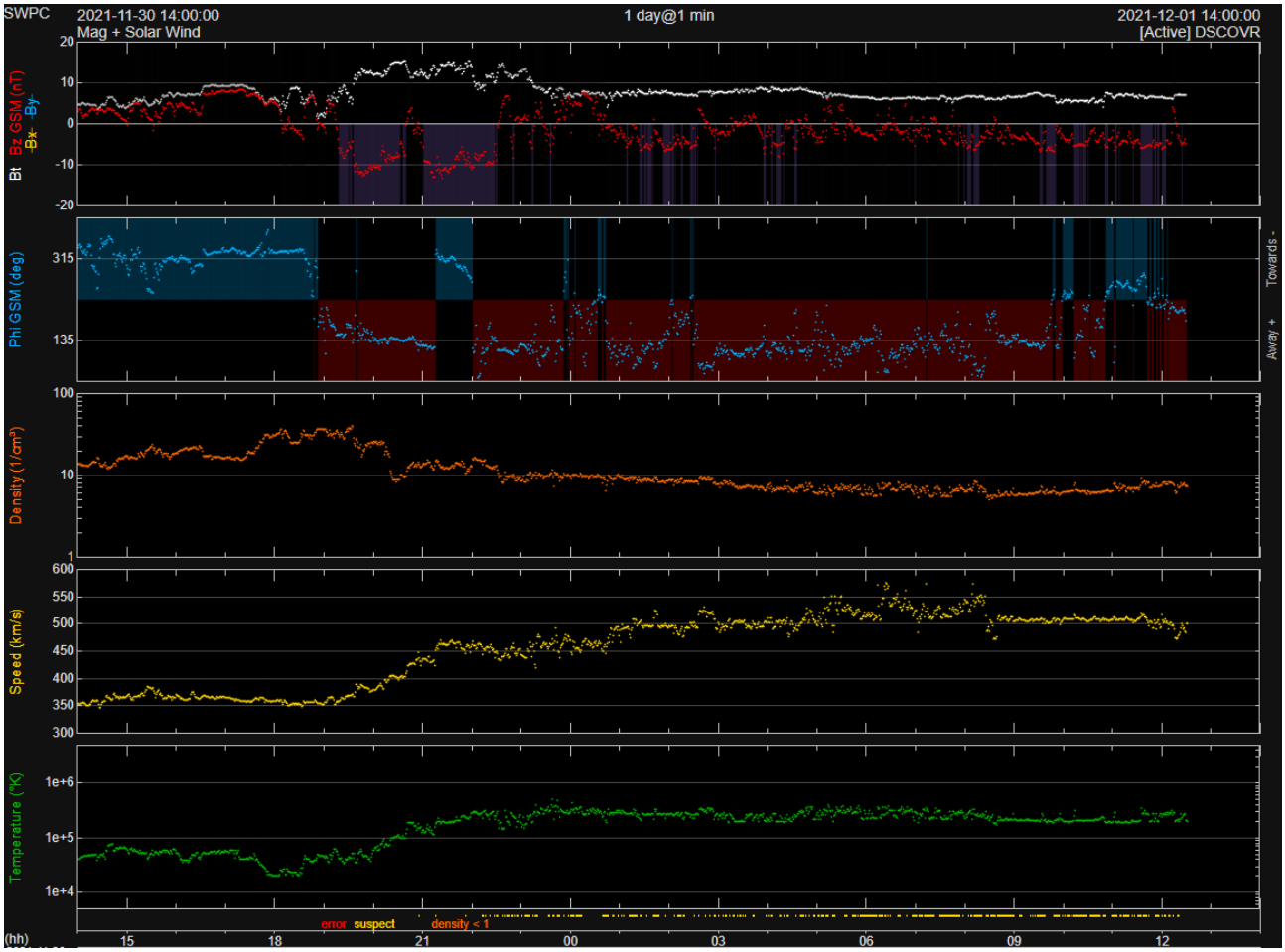
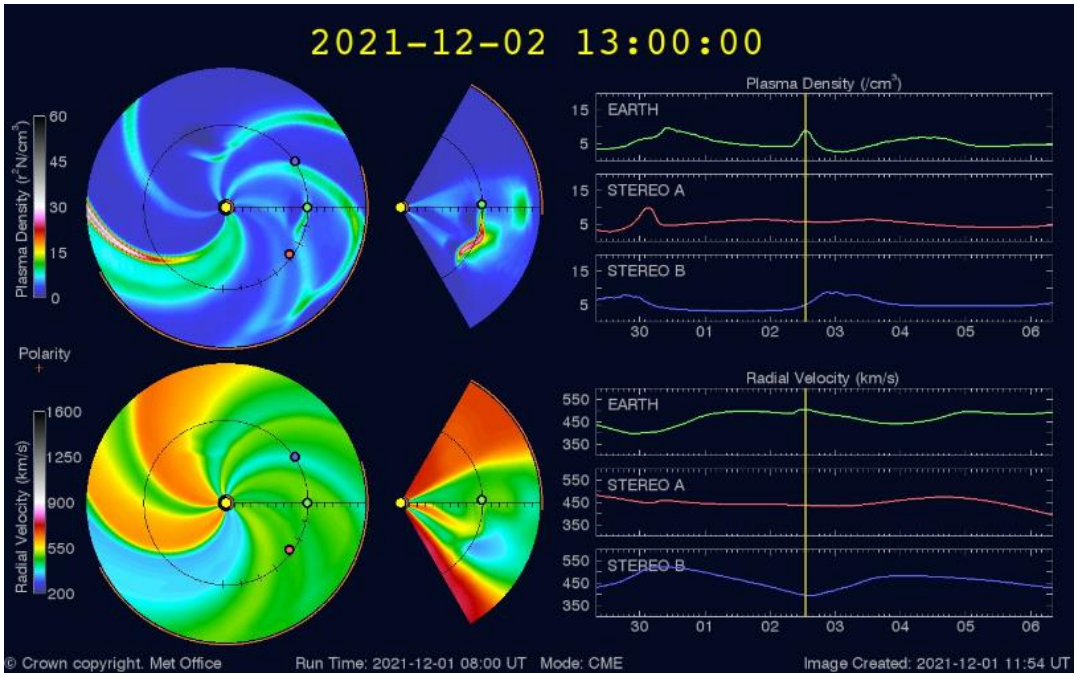


Figure 3: Latest Enlil forecast, suggesting a possible CME glancing blow on 2nd Dec



Radio Blackouts - X-Ray Flares:

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Flare activity is currently very low, with any enhancement to the X-ray flux most likely from ARs 2898 (Cao/Beta) and 2900 (Dao/Beta) in the southeast, although both likely to move away around the east limb through this forecast period. AR2902 (Dro/Beta) in the northwest is showing some increased penumbra development, but remains relatively simple at this stage. Region 2901 (Bxo/Beta) in the northeast is now increasingly weak and difficult to see. Finally, far side data would suggest no significant regions expected to move into view around the east limb during this period.

Solar activity is likely to remain low or very low, with a chance of C-class flares, and a very slight chance of an M-flare.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is forecast to remain at background levels, with no solar radiation storms anticipated.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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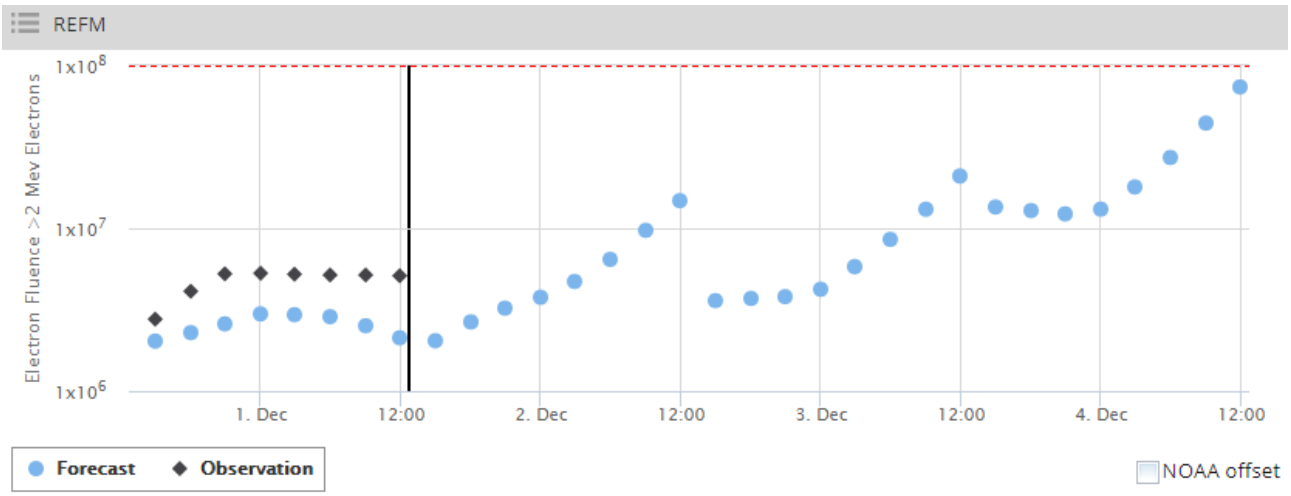
High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux as observed by GOES-16 at GEO has been at background to moderate levels during the last 24 hours, and is expected to continue at similar levels until a connection to a faster stream of solar wind occurs. The next potential enhancement is likely to be from the faster wind of CH27 from day 2 (2nd) possibly increasing diurnal maximum levels to high by the end of the period, however confidence is low.
With flux likely to remain below the high level until later in the period, the associated 24 hour integrated fluence is expected to remain below the Active threshold, with a general rising trend but only a slight chance of rising above at the end of the period. This is supported by REFM which maintains fluence levels at well below the Active threshold.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}\,sr^{-1}\,day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	5	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: Latest MOSWOC REFM data, rising trend accepted



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